UNIT 4

Orientation and Traveling

CHAPTER 4-1

Land Navigation

Survivors must know their location in order to intelligently decide if they should wait for rescue or if they should determine a destination and (or) route to travel. If the decision is to stay, the survivors need to know their location in order to radio the information to rescue personnel. If the decision is to travel, survivors must be able to use a map to determine the best routes of travel, location of possible food and water, and dangerous areas which they should avoid.

This chapter provides background information in the use of the map and compass (fig. 4-1).

Maps

A map is a pictorial representation of the Earth's surface drawn to scale and reproduced in two dimensions. Every map should have a title, legend, scale, north arrow, grid system, and contour lines. With these components, survivors can determine the portion of the Earth's surface the map covers. Survivors should be able to understand all of the markings on the map and use them to their advantage. They should also be able to determine the distance between any two points on the map and be able to line up the map with true north so it conforms to the actual features on the ground.

A map is a picture of the Earth's surface as seen from above, simplified to bring out important details and lettered for added identification. A map represents what is known about the Earth rather than what can be seen by an observer. However, a map is selective in that only the information which is necessary for its intended use is included on any one map. Maps also include features which are not visible on Earth, such as parallels, meridians, and political boundaries.

Since it is impossible to correctly portray a round object, such as the Earth, on a flat surface, all maps have some elements that are misrepresented. Depending on the intended use, some maps sacrifice constant scale for accuracy in measurement of angles, while others sacrifice accurate measurement of angles for a constant scale. However, most maps used for ground navigation use a compromise projection and the elements which the map portrays, is a fairly true picture.

A planimetric map presents only the horizontal positions for the features represented. It is distinguished from a topographic map by the omission of relief in a measurable form.

A topographic map (fig. 4-2) portrays terrain and landforms in a measurable form and the horizontal positions of the features represented. The vertical positions, or relief, are normally represented by contours. On maps showing relief, the elevations and contours are usually measured from sea level.

A plastic relief map is a reproduction of an aerial photograph upon which grid lines, marginal data, place names, route numbers, important elevations, boundaries, approximate scale, and approximate direction have been added.

Topographic Map Symbols and Colors

The purpose of a map is to permit one to visualize an area of the Earth's surface with pertinent features properly positioned. Ideally, all the features within an area would appear on the map in their true proportion, position, and shape. This, however, is not practical because many of the features would be unimportant and others would be unrecognizable because of their reduction in size. The mapmaker has been forced to use symbols to represent the natural and manmade features of the Earth's surface. These symbols resemble, as closely as possible, the actual features as viewed from above (figs. 4-3 and 4-4).

To facilitate identification of features on the map by providing more natural appearance and contrast, the topographic symbols are usually printed in different colors, with each color identifying a class of features. The colors vary with different types of maps, but on a standard large-scale topographic map, the colors used and the features represented are:

1. Black—the majority of cultural or manmade features.
2. Blue—water features such as lakes, rivers, and swamps.
3. Green—vegetation such as woods, orchards, and vineyards.
4. Brown-all relief features such as contours.
5. Red—main roads, built-up areas, and special features.
6. Occasionally, other colors may be used to show special information. (These, as a rule, are indicated in the marginal information).

In the process of making a map, everything must be reduced from its size on the ground to the size which appears on the map. For purposes of clarity, this requires some of the symbols to be over estimated. They are positioned so that the center of the symbol remains in its true location. An exception to this would be the position of a feature adjacent to a major road. If the width of the road has been exaggerated, then the feature is moved from its true position to preserve its relation to the road.

Army Field Manual 21-31 gives a description of topographic symbols and abbreviations authorized for use on U.S. military maps. Figure 4-5 illustrates several of the symbols used on maps.

Coordinate Systems

The intersections of reference lines help to locate specific points on the Earth's surface. Three of the primary reference line systems are the geographic coordinate system, the reference (GEOREF) system, and the universal transverse mercator grid system (UTM). Knowing how to use these plotting systems should help a survivor to determine point locations.

Coordinates

Quantities that give position with respect to two reference lines are called coordinates. Thus, the intersection of F Street and 4th Avenue (fig. 4-6) is the coordinate location of the Gridville Public Library. The coordinates of the local theater are D Street and 6th Avenue. One can see from this simplified example that coordinates are read at intersections of vertical and horizontal lines. The basic coordinate system used on maps and charts is the geographic military grid. The structure and use of the geographic coordinate system, the world geographic reference system, and the military grid reference system will be discussed and illustrated.

Geographic Coordinates. The geographic coordinate system is a network of imaginary lines that circle the Earth. They are used to express Earth position or location. There are north-south lines called meridians of longitude and east-west lines named parallels of latitude. The location of any point on the Earth can be expressed in terms of the intersection of the line of latitude and the line of longitude passing through the point.

Meridians of Longitude. The lines of latitude and longitude are actually great and small circles formed by imaginary planes cutting the Earth. A great circle divides the Earth into two equal parts (halves); whereas, a small circle divides the Earth into two unequal parts. Study figure 4-7 and note that: (1) each north-south line is a great circle, and (2) each great circle passes through both the North and South Poles. Each half of each of these great circles from one pole, in either direction, to the other pole is called a meridian of longitude. The other half of the same great circle is a second meridian of longitude.

Meridian is derived from the Latin word “meridianum,” which means “lines that pass through the highest point on their course” (in this case, both the North and South Poles). Any angular distance measured east or west of the meridian is called longitudinal distance;

hence, the term "meridian of longitude." It is necessary, of course, to assign values to the meridians to make them meaningful. The most appropriate values to use for circles are degrees (º), minutes ('), and seconds ("). Circles are customarily divided into 360º per circle, 60º per degree, and 60" per minute.

All meridians are equal in value; hence, one of them must be assigned the value of 0º (the starting point). The meridian passing through Greenwich, England, is zero degrees (0º). This meridian is also called the prime meridian (fig. 4-7). The other half of the great circle on which the prime meridian is located is designated the 180th meridian. Portions of this meridian are also called the international dateline.

From the prime meridian east of the international dateline, meridians are assigned values of 0º through 180º east. Similarly, from the prime meridian west to the international dateline, meridians are assigned values of 0º through 180º west. The 0º meridian together with the 180º meridian forms a great circle which divides the Earth into east and west longitude (or hemispheres). There are 180º of east longitude plus 180º of west longitude for 360º of longitude.

Parallels of Latitude. Notice in figure 4-8 that the circles running in an east-west direction are of varying diameters (sizes). Only the circle designated "Equator" is a great circle. All others are small circles. Note that all circles are parallel to the Equator and run laterally around the Earth. Hence, each circle is called a parallel of latitude. Unlike meridians, which extend only halfway around the Earth, a parallel of latitude extends all the way around the Earth; for the record, the Equator is also a parallel of latitude. Since the Equator is the only great circle of latitude, it is a natural starting point for the 0º value of latitude. The North and South Poles are designated 90º north latitude and 90º south latitude, respectively. Parallels between the Equator and North Pole carry values between 0º and 90º north; parallels between the Equator and the South Pole are assigned values between 0º and 90º south.

Figure 4-9 combines the lines of latitude and longitude. Lines 0º through 90º north or south latitude and 0º through 180º east or west longitude form the grid of the geographic coordinate system. Study the positions of Points A and B in figure 4-9. Determine the geographic coordinates of each in degrees. Note that point A is positioned 32º north of the Equator and 35º east of the prime meridian. The geographic position of point A, therefore, is 32º north 35º east. Point B is located 25º south of the Equator and 40º west of the prime ºmeridian. Hence, the geographic position of point B is 25º south 40º west.

Just as any point within the city of Gridville (fig. 4-6) can be referenced by the intersection of two imaginary lines, any point on the Earth's surface can be referenced by the intersection of the imaginary lines of latitude and longitude.

Writing Geographic Coordinates

To illustrate the proper way to write geographic coordinates, let's assume that a person needs to write the coordinates of a target. The target is located 30º20' north of the Equator and 135º06' east of the prime meridian. Thus, the position is located at 30º20' north latitude and 135º06' east longitude. By combining latitude and longitude, the position of the geographic location can be expressed as 30º20'N 135º06'E. To write these coordinates in the correct military form, eliminate the degree (º) and minute (') symbols. Thus, the coordinates would be written 302000Nl350600E.

Writing geographic coordinates in the military form is necessary for wire and radio transmission of geographic coordinates. Why? The transmission equipment does not include the degree (º), minute ('), and second (") characters in its keyboards. Coordinates are also stored in automated data processing computers which are programmed to handle coordinates in military characters or spaces. If the sequence of numbers and letters fed into a computer is less than 15 spaces, or in error, the resulting printout will be meaningless.

When a position is located that is less than 10º latitude, a zero is added to the left of the degree number. For example, 7º of latitude is written as 07. Likewise, two digits always designate minutes and two digits for seconds. Thus, 7ºN becomes 07N; 7º6'N becomes 0706N; and 7º6'5"N becomes 070605N. In expressing longitude, three digits are required to indicate degrees, two digits for minutes, and two digits for seconds. Thus 8ºE becomes 008E; 8º5'E becomes 00805E; and 8º5'4"E becomes 0080504E.

In general, there are five rules to follow in correctly writing geographic coordinates:

1. Write latitude first, followed by longitude.
2. Use an even number of digits for latitude and an odd number of digits for longitude.
3. Do not use a dash or leave a space between latitude and longitude.
4. Use a single upper case letter to indicate direction from the Equator and prime meridians.
5. Omit the symbols for degrees, minutes, and seconds.

Elevation and Relief

A knowledge of map symbols, grids, scale, and distance gives enough information to identify two points, locate them, measure between them, and determine how long it would take to travel between them. But what happens if there is an obstacle between the two points? The map user must become proficient in recognizing various landforms and irregularities of the Earth's surface and be able to determine the elevation and differences in height of all terrain features.

Datum Plane

This is the reference used for vertical measurements. The datum plane for most maps is mean or average sea level.

Elevation

This is defined as the height (vertical distance) of an object above or below a datum plane.

Relief

Relief is the representation of the shape and height of landforms and characteristic of the Earth's surface.

Contour Lines

There are several ways of indicating elevation and relief on maps. The most common way is by contour lines. A contour line is an imaginary line connecting points of equal elevation. Contour lines indicate a vertical distance above or below a datum plane. Starting at sea level, each contour line represents an elevation above sea level. The vertical distance between adjacent contour lines is known as the contour interval. The amount of contour interval is given in the marginal information. On most maps, the contour lines are printed in brown. Starting at zero elevation, every fifth contour line is drawn with a heavier line. These are known as index contours and somewhere along each index contour, the line is broken and its elevation is given. The contour lines falling between index contours are called intermediate contours. They are drawn with a finer line than the index contours and usually do not have their elevations given.

Using the contour lines on a map, the elevation of any point may be determined by:

- Finding the contour interval of the map from the marginal information, and noting the amount and unit of measure.
- Finding the numbered contour line (or other given elevation) nearest the point for which elevation is being sought.
- Determining the direction of slope from the numbered contour line to the desired point.
- Counting the number of contour lines that must be crossed to go from the numbered line to the desired point and noting the direction—up or down.

The number of lines crossed multiplied by the contour interval is the distance above or below the starting value. If the desired point is on a contour line, its elevation is that of the contour; for a point between contours, most military needs are satisfied by estimating the elevation to an accuracy of one-half the contour interval. All points less than one-fourth the distance between the lines are considered to be at the same elevation as the line.

To estimate the elevation of the top of an unmarked hill add half the contour interval to the elevation of the highest contour line around the hill. To estimate the elevation of the bottom of a depression, subtract half the contour interval from the value of the lowest contour around the depression.

On maps where the index and intermediate contour lines do not show the elevation and relief in as much detail as may be needed, supplementary contour may be used. These contour lines are dashed brown lines, usually at one-half the contour interval for the map. A note in the marginal information indicates the interval used. They are used exactly as are the solid contour lines.

On some maps contour lines may not meet the standards of accuracy but are sufficiently accurate in both value and interval to be shown as contour rather than as form lines. In such cases, the contours are considered as approximate and are shown with a dashed symbol; elevation values are given at intervals along the heavier (index contour) dashed lines. The contour note in the map margin identifies them as approximate contours.

In addition to the contour lines, bench marks and spot elevations are used to indicate points of known elevation on the map. Bench marks, the more precise of the two, are symbolized by a black X, as X BM 124. The elevation value shown in black refers to the center of the X. Spot elevations shown in brown generally are located at road junctions, on hilltops, and other prominent landforms. The symbol designates an accurate horizontal control point. When a bench mark and a horizontal control point are located at the same point, the symbol BM is used.

The spacing of the contour lines indicates the nature of the slope. Contour lines evenly spaced and wide apart indicate a uniform, gentle slope (fig. 4-10). Contour lines evenly spaced and close together indicate a uniform, steep slope. The closer the contour lines to each other, the steeper the slope (fig. 4-11). Contour lines closely spaced at the top and widely spaced at the bottom indicate a concave slope (fig. 4-12). Contour lines widely spaced at the top and closely spaced at the bottom indicate a convex slope (fig. 4-13).

To show the relationship of land formations to each other and how they are symbolized on a contour map, stylized panoramic sketches of the major relief formations were drawn and a contour map of each sketch developed. Each figure (figs. 4-14 through 4-18) shows a sketch and a map with a different relief feature and its characteristic contour pattern.

Hill. A point or small area of high ground (fig. 4-14). When one is located on a hilltop, the ground slopes down in all directions.

Valley. Usually a stream course which has at least a limited extent of reasonably level ground bordered on the sides by higher ground (fig. 4-15A). The valley generally has maneuvering room within its confines. Contours indicating a valley are U-shaped and tend to parallel a major stream before crossing it. The more gradual the fall of a stream, the farther each contour inner part. The curve of the contour crossing always points upstream.

Drainage. A less-developed stream course in which there is essentially no level ground and, therefore, little or no maneuvering room within its confines (fig. 4-15B). The ground slopes upward on each side and toward the head of the drainage. Drainages occur frequently along the sides of ridges, at right angles to the valleys between the ridges. Contours indicating a drainage are V-shaped, with the point of the “V” toward the head of the drainage.

Ridge. A range of hills or mountains with normally minor variations along its crest (fig. 4-16A). The ridge is not simply a line of hills; all points of the ridge crest are appreciably higher than the ground on both sides of the ridge.

Finger Ridge. A ridge or line of elevation projecting from or subordinate to the main body of a mountain or mountain range (fig. 4-16B). A finger ridge is often formed by two roughly parallel streams cutting drainages down the side of the ridge.

Saddle. A dip or low point along the crest of a ridge. A saddle is not necessarily the lower ground between two hilltops; it may simply be a dip or break along an otherwise level ridge crest (fig. 4-17).

Depression. A low point or sinkhole surrounded on all sides by higher ground (fig. 4-18).

Cuts and Fills. Manmade features by which the bed of a road or railroad is graded or leveled off by cutting through high areas (fig. 4-19A) and filling in low areas (fig. 4-19B) along the right-of-way.

Cliff. A vertical or near vertical slope (fig. 4-20). When a slope is so steep that it cannot be shown at the contour interval without the contours fusing, it is shown by a ticked “carrying” contour(s). The ticks always point toward lower ground.

Representative Fraction (RF)

The numerical scale of a map expresses the ratio of horizontal distance on the map to the corresponding horizontal distance on the ground. It usually is written as a fraction, called the representative fraction (RF). The representative fraction is always written with the map distance as one (1). It is independent of any unit of measure. An RF of 1/50,000 or 1:50,000 means that one (1) unit of measure on the map is equal to 50,000 of the same units of measure on the ground.

The ground distance between two points is determined by measuring between the points on the map and multiplying the map measurement by the denominator of the RF.

Example: RF= 1:50,000 or $\frac{1}{50,000}$

Map distance = 5 units (CM)

5 X 50,000 - 250,000 units (CM) of ground distance (fig. 4-21)

When determining ground distance from a map, the scale of the map affects the accuracy. As the scale becomes smaller, the accuracy of measurement decreases because some of the features on the map must be exaggerated so that they may be readily identified.

Graphic (Bar) Scales

On most military maps, there is another method of determining ground distance. It is by means of the graphic (bar) scales. A graphic scale is a ruler printed on the map on which distances on the map may be measured as actual ground distances. To the right of the zero (0), the scale is marked in full units of measure and is called the primary scale. The part to the left of zero (0) is divided into tenths of a unit and is called the extension scale, each of which measures distance in a different unit of measure (fig. 4-22).

To determine a straight-line ground distance between two points on a map, lay a straight-edged piece of paper on the map so that the edge of the paper touches both points. Mark the edge of the paper at each point. Move the paper down to the graphic scale and read the ground distance between the points. Be sure to use the scale that measures in the unit of measure desired (fig. 4-23).

To measure distance along a winding road, stream, or any other curved line, the straightedge of a piece of paper is used again. Mark one end of the paper and place it at the point from which the curved line is to be measured. Align the edge of the paper along a straight portion and mark both the map and the paper at the end of the aligned portion. Keeping both marks together, place the point of the pencil on the mark on the paper to hold it in place. Pivot the paper until another approximately straight portion is aligned and again mark on the map and the paper. Continue in this manner until measurement is complete. Then place the paper on the graphic scale and read the ground distance (fig. 4-24).

Using a Map and Compass, and Expressing Direction

To use a map, the map must correspond to the lay of the land, and the user must have a knowledge of direction and how the map relates to the cardinal directions. In essence, to use a map for land navigation, the map must be "oriented" to the lay of the land. This is usually done with a compass. On most maps, either a declination diagram, compass rose, and lines of map magnetic variations are provided to inform the user of the difference between magnetic north and true north.

Directions are expressed in everyday life as right, left, straight ahead, etc.; but the question arises, "to the right of what?" Military personnel require a method of expressing direction which is accurate, adaptable for use in any area of the world, and has a common unit of measure. Directions are expressed as units of angular measure. The most commonly used unit of angular measure is the degree with its subdivisions of minutes and seconds.

Baselines. To measure anything, there must always be a starting point or zero measurement. To express a direction as a unit of angular measure, there must be a starting point or zero measure and a point of reference. These two points designate the base or reference line. There are three baselines—true north, magnetic north, and grid north. Those most commonly used are magnetic and grid—the magnetic when working with a compass, and the grid when working with a military map.

True North. A line from any position on the Earth's surface to the North Pole. All lines of longitude are true north lines. True north is usually symbolized by a star (fig. 4-25).

Magnetic North. The direction to the north magnetic pole, as indicated by the north-seeking needle of a magnetic instrument. Magnetic north is usually symbolized by a half arrowhead (fig. 4-25).

Grid North. The north established by the vertical grid lines on the map. Grid north may be symbolized by the letters GN or the letter Y.

Azimuth and Back Azimuth. The most common method used by the military for expressing a direction is azimuths. An azimuth is defined as a horizontal angle, measured in a clockwise manner from a north baseline. When the azimuth between two points on a map is desired, the points are joined by a straight line and a protractor is used to measure the angle between north and the drawn line. This measured angle is the azimuth of the drawn line (fig. 4-26). When using an azimuth, the point from which the azimuth originates is imagined to be the center of the azimuth circle (fig. 4-27). Azimuths take their name from the baseline from which they are measured; true azimuths from true north, magnetic azimuths from magnetic north, and grid azimuths from grid north (fig. 4-25). Therefore, any given direction can be expressed in three different ways: a grid azimuth if measured on a military map, a magnetic azimuth if measured by a compass, or a true azimuth if measured from a meridian of longitude.

A back azimuth is the reverse direction of an azimuth. It is comparable to doing an "about face." To obtain a back azimuth from an azimuth, add 180º if the azimuth is 180º or less, or subtract 180º if the azimuth is 180º or more (fig. 4-28). The back azimuth of 180º may be stated as either 000º or 360º.

The Compass and Its Uses. The magnetic compass is the most commonly used and simplest instrument for measuring directions and angles in the field. The lensatic compass (fig. 4-28) is the standard magnetic compass for military use today.

The lensatic compass must always be held level and firm when sighting on an object and reading an azimuth (fig. 4-29). There are several techniques for holding the compass and sighting. One way is to align the sighting slot with the hairline on the front sight in the cover and the target. The azimuth can then be read by glancing down at the dial through the lens. This technique provides a reading precise enough to use.

Night Use of the Compass. For night use, special features of the compass include the luminous markings, the bezel ring, and two luminous sighting dots. Turning the bezel ring counterclockwise causes an increase in azimuth, while turning it clockwise causes a decrease. The bezel ring has a stop and spring which allows turns at 3º intervals per click and holds it at any desired position. One accepted method for determining compass directions at night is:

- Rotate the bezel ring until the luminous line is over the black index line.
- Hold the compass with one hand and rotate the bezel ring in a counterclockwise direction with the other hand to the number of clicks required. The number of clicks is determined by dividing the value of the required azimuth by 3. For example, for an azimuth of 51º, the bezel ring would be rotated 17 clicks counterclockwise (fig. 4-30).
- Turn the compass until the north arrow is directly under the luminous line on the bezel.

- Hold the compass open and level in the palm of the left hand with the thumb along the side of the compass.

In this manner, the compass can be held consistently in the same position. Position the compass approximately halfway between the chin and the belt, pointing to the direct front. (Practice in daylight will make a person skilled in pointing the compass the same way every time.) Looking directly down into the compass, turn the body until the north arrow is under the luminous line. Then proceed forward in the direction of the luminous sighting dots (fig. 4-31). When the compass is to be used in darkness, an initial azimuth should be set while light is still available. With this initial azimuth as a base, any other azimuth which is a multiple of 3º can be established through use of the clicking feature of the bezel ring. The magnetic compass is a delicate instrument, especially the dial balance. The survivor should take care in its use. Compass readings should never be taken near visible masses of iron or electrical circuits.

A watch can be used to determine the approximate true north or south (fig. 4-32). In the northern hemisphere, the hour hand is pointed toward the Sun. A south line can be found midway between the hour hand and 1200 standard time. During daylight savings time, the north-south line is midway between the hour hand and 1300. If there is any doubt as to which end of the line is north, remember that the Sun is in the east before noon and in the west in the afternoon.

CHAPTER 4-2

Navigation Using the Sun and the Stars

Direction Findings

In a survival situation, you will be extremely fortunate if you happen to have a map and compass. If you do have these two pieces of equipment, you will most likely to be able to move toward help. If you are not proficient in using a map and compass, you must take the steps to gain this skill.

There are several methods by which you can determine direction by using the Sun and the stars. These methods, however, will give you only a general direction. You can come up with a more nearly true direction if you know the terrain of the territory or country.

You must learn all you can about the terrain of the country or territory to which you or your unit may be sent, especially any prominent features or landmarks. This knowledge of the terrain together with using the methods explained below will let you come up with fairly true directions to help you navigate.

Using the Sun and Shadows

The Earth's relationship to the Sun can help you to determine direction on Earth. The Sun always rises in the east and sets in the west, but not exactly due east or due west. There is also some seasonal variation. In the northern hemisphere, the Sun will be due south when at its highest point in the sky, or when an object casts no appreciable shadow. In the southern hemisphere, this same noonday Sun will mark due north. In the northern hemisphere, shadows will move clockwise. Shadows will move counterclockwise in the southern hemisphere. With practice, you can use shadows to determine both direction and time of day. The shadow methods used for direction finding are the shadow-tip and watch methods.

Shadow-Tip Methods

In the first shadow-tip method, find a straight stick 1 meter long, and a level spot free of brush on which the stick will cast a definite shadow. This method is simple and precise and consists of four steps:

- *Step 1.* Place the stick or branch into the ground at a level spot where it will cast a unique shadow. Mark the shadow's tip with a stone, twig, or other means. This first shadow mark is always west—everywhere on Earth.
- *Step 2.* Wait 10 to 15 minutes until the shadow tip moves a few centimeters. Mark the shadow tip's new position in the same way as the first.
- *Step 3.* Draw a straight line through the two marks to obtain an approximate east-west line.
- *Step 4.* Stand with the first mark (west) to your left and the second mark to your right—you are now facing north. This fact is true everywhere on Earth.

An alternate method is more precise but requires more time. Set up your shadow stick and mark the first shadow in the morning. Use a piece of string to draw a clean arc through this mark and around the stick. At midday, the shadow will shrink and disappear. In the afternoon, it will lengthen again and at the point where it touches the arc, make a second mark. Draw a line through the two marks to get an accurate east-west line (fig. 4-33).

The Watch Method

You can also determine direction using a common or analog watch—one that has hands. The direction will be accurate if you are using true local time, without any changes for daylight savings time. Remember, the further you are from the equator, the more accurate this method will be. If you only have a digital watch, you can overcome this obstacle. Quickly draw a watch on a circle of paper with the correct time on it and use it to determine your direction at that time.

In the northern hemisphere, hold the watch horizontal and point the hour hand at the Sun. Bisect the angle between the hour hand and the 12 o'clock mark to get the north-south line (fig. 4-34). If there is any doubt as to which end of the line is north, remember that the Sun rises in the east, sets in the west, and is due south at noon. The Sun is in the east before noon and in the west after noon.

Note: *If your watch is set on daylight savings time, use the midway point between the hour hand and 1 o'clock to determine the north-south line.*

In the southern hemisphere, point the watch's 12 o'clock mark toward the Sun and a midpoint halfway between 12 and the hour hand will give you the north-south line (fig. 4-34).

Using the Moon

Because the Moon has no light of its own, we can only see it when it reflects the Sun's light. As it orbits the Earth on its 28-day circuit, the shape of the reflected light varies according to its position. We say there is a new Moon or no Moon when it is on the opposite side of the Earth from the Sun. Then, as it moves away from the Earth's shadow, it begins to reflect light from its right side and waxes to become a full Moon before waning, or losing shape, to appear as a sliver on the left side. You can use this information to identify direction.

If the Moon rises before the Sun has set, the illuminated side will be the west. If the Moon rises after midnight, the illuminated side will be the east. This obvious discovery provides us with a rough east-west direction during the night.

Constellation: The arrangement of stars; One of 88 stellar groups named after and thought to resemble various mythological characters, objects, and animals.

Using the Stars

Your location in the Northern or Southern Hemisphere determines which **constellation** you use to determine your north or south direction.

The Northern Sky

The main constellations to learn are the Ursa Major, also known as the Big Dipper or the Plow, and Cassiopeia (fig. 4-35). Neither of these constellations ever sets. They are always visible on a clear night. Use them to locate Polaris, also known as the polestar or the North Star. The North Star forms part of the Little Dipper handle and can be confused with the Big Dipper. Prevent confusion by using both the Big Dipper and Cassiopeia together. The Big Dipper and Cassiopeia are always directly opposite each other and rotate counterclockwise around Polaris, with Polaris in the center. The Big Dipper is a seven star constellation in the shape of a dipper. The two stars forming the outer lip of this dipper are the "pointer stars" because they point to the North Star. Mentally draw a line from the outer bottom star to the outer top star of the Big Dipper's bucket. Extend this line about five times the distance between the pointer stars. You will find the North Star along this line.

Cassiopeia has five stars that form a shape like a "W" on its side. The North Star is straight out from Cassiopeia's center star.

After locating the North Star, locate the North Pole or true north by drawing an imaginary line directly to the Earth.

The Southern Sky

Because there is no star bright enough to be easily recognized near the south celestial pole, a constellation known as the Southern Cross is used as a signpost to the South (fig. 4-36). The Southern Cross or Crux has five stars. Its four brightest stars form a cross that tilts to one side. The two stars that make up the cross's long axis are the pointer stars. To determine south, imagine a distance five times the distance between these stars and the point where this imaginary line ends is in the general direction of south. Look down to the horizon from this imaginary point and select a landmark to steer by. In a static survival situation, you can fix this location in daylight if you drive stakes in the ground at night to point the way.

Making Improvised Compasses

You can construct improvised compasses using a piece of ferrous metal that can be needle shaped or a flat double-edged razor blade and a piece of nonmetallic string or long hair from which to suspend it. You can magnetize or polarize the metal by slowly stroking it in one direction on a piece of silk or carefully through your hair using deliberate strokes. You can also polarize metal by stroking it repeatedly at one end with a magnet. Always rub in one direction only. If you have a battery and some electric wire, you can polarize the metal electrically. The wire should be insulated. If not insulated, wrap the metal object in a single, thin strip of paper to prevent contact. The battery must be a minimum of 2 volts. Form a coil with the electric wire and touch its ends to the battery's terminals. Repeatedly insert one end of the metal object in and out of the coil. The needle will become an electromagnet. When suspended from a piece of nonmetallic string, or floated on a small piece of wood in water, it will align itself with a north-south line.

You can construct a more detailed improvised compass using a sewing needle or thin metallic object, a nonmetallic container (for example, a plastic dip container), its lid with the center cut out and waterproofed, and the silver tip from a pen. To construct this compass, take an ordinary sewing needle and break in half. One half will form your direction pointer and the other will act as the pivot point. Push the portion used as the pivot point through the bottom center of your container; this portion should be flush on the bottom and not interfere with the lid. Attach the center of the other portion (the pointer) of the needle on the pen's silver tip using glue, tree sap, or melted plastic. Magnetize one end of the pointer and rest it on the pivot point.

Other Means of Determining Direction

The old saying about using moss on a tree to indicate north is not accurate because moss grow completely around some trees. Actually, growth is more lush on the side of the tree facing the south in the Northern Hemisphere and vice versa in the Southern Hemisphere. If there are several felled trees around for comparison, look at the stumps. Growth is more vigorous on the side toward the equator and the tree growth rings will be more widely spaced. On the other hand, the tree growth rings will be closer together on the side toward the poles.

Wind direction may be helpful in some instances where there are prevailing directions and you know what they are.

Recognizing the differences between vegetation and moisture patterns on north- and south-facing slopes can aid in determining direction. In the northern hemisphere, north-facing slopes receive less Sun than south-facing slopes and are therefore cooler and damper. In the summer, north-facing slopes retain patches of snow. In the winter, the trees open areas on south-facing slopes are the first to lose their snow, and ground snowpack is shallower.

CHAPTER 4-3

Land Travel

In any survival situation following an emergency, a decision must be made to either move or remain as close as possible to the present site. In this chapter, land travel will be discussed and the various considerations that survivors should address before determining if travel is or is not a necessity.

Survivors may need to carry supplies and equipment while traveling to sustain life. For this reason, the techniques of backpacking and improvised packing are discussed to help a person do this task.

As a survivor, the ability to walk plainly is important in safeguarding energy and safety. Additionally, in rough terrain, travel may need to be done with the aid of a rope. The techniques of **ascending** and **descending** steep terrain are necessary to understanding and performing rescue from rough terrain. These techniques, as well as techniques for snow travel, are covered. Travel may not be easy, but a knowledgeable traveler can travel safely and clearly while saving time and energy.

Ascending: To move gradually upward.
Descending: To pass from a higher place or level to a lower one.

Decision to Stay or Travel

The best advice is to stay with the aircraft or automobile. Most rescues have been made when survivors remained with the vehicle.

Survivors should only leave the area when they are certain of their location and know that water, shelter, food, and help can be reached, or after having waited several days, they are convinced that rescue is not coming and they are equipped to travel.

Before making any decision, survivors should consider their personal physical condition and the condition of others in the party when estimating their ability to sustain travel. If people are injured, they should try to get help. If travel for help is required, they should send the people who are in the best physical and mental condition. Send two people if possible. To travel alone is dangerous. Before any decision is made, survivors should consider all of the facts.

If the decision is to stay, these problems should be considered:

- Environmental conditions.
- Health and body care; camp sanitation.
- Rest and shelter.
- Water supplies.
- Food.

If the decision is to travel: In addition to the primary survival problems of providing food, water, and shelter, the following must be considered:

- Direction of travel and why.
- Travel plan.
- Equipment required.

Before departing the site, survivors should leave information at their vehicle stating departure time, destination, route of travel, personal condition, and available supplies.

From the air, it is easier to spot the vehicle than it is to spot people traveling on the ground. Someone may have seen the crash and investigate. The vehicle or parts from it can provide shelter, signaling aids, and other equipment (cowling for reflecting signals, tubing for shelter framework, gasoline and oil for fires, etc.). Avoiding the hazards and difficulties of travel is another reason to stay with the vehicle. Rescue changes are good if weather and air observation conditions are good.

Present location must be known to decide intelligently whether to wait for rescue or to determine a route of travel. The survivors should try to locate their position by studying maps, and landmarks, or by taking celestial observations. Downed personnel should try to determine the nearest rescue point, the distance to it, the possible difficulties and hazards of travel, and the appropriate facilities and supplies en route and at the destination.

There are a number of other factors that should be considered when deciding to travel.

The equipment and materials required for cross-country travel should be analyzed. Travel is extremely risky unless the necessities of survival are available to provide support during travel. Survivors should have plenty of water to reach the next likely water source indicated on a map or chart and enough food to last until they can get some more food. To leave shelter to travel in adverse weather conditions is usually foolhardy.

In addition to the basic requirements, the physical condition of the survivor must be considered in any decision to travel. If in good condition, the survivor should be able to move an appreciable distance, but if the survivor is not in good condition or is injured, the ability to travel extended distances may be reduced. Analyze all injuries received during the emergency. For example, if a leg or ankle is injured, this must be considered before traveling.

If possible, survivors should avoid making any decision immediately after the emergency. They should wait a period of time to allow for recovery from the mental—if not the physical—shock resulting from the emergency. When shock has subsided survivors can then evaluate the situation, analyze the factors involved, and make valid decisions.

Travel

Once the survivors decide to travel, there are several considerations that apply regardless of the circumstances.

The ranking person must assume leadership, and the party must work as a team to ensure that all tasks are done in an equitable manner. Full use should be made of any survival experience or knowledge possessed by members of the group, and the leader is responsible for ensuring that the talents of all survivors are used.

Hallucination: False or distorted perception of objects or events with an overwhelming sense of reality.

Precipitation: A deposit on the Earth of hail, mist, rain, sleet, or snow.

Survivors should keep the body's energy output at a steady rate to reduce the effects of unaccustomed physical demands.

A realistic pace should be maintained to save energy. It increases durability and keeps body temperature stable because it reduces the practice of quick starts and lengthy rests. More importantly, a moderate, realistic pace is essential in high altitudes in avoiding the risks of lapse of judgment and **hallucinations** due to lack of oxygen (hypoxia). Travel speed should provide for each survivor's physical condition and daily needs, and the group pace should be governed by the pace of the slowest group member. Additionally, rhythmic breathing should be practiced to prevent headache, nausea, lack of appetite, and irritability.

Rest stops should be short since it requires added energy to begin again after cooling off. Survivors should wear their clothing in layers (layer system) and make adjustments to provide for climate, temperature, and **precipitation**. It is better to start with extra clothing and stop and shed a layer when beginning to warm up.

Wearing loose clothing provides for air circulation, allows body moisture to evaporate, and retains body heat. Loose clothing also allows freedom of movement.

Travelers should keep in mind when planning travel time and distance that the larger the group, the slower the progress will be. Time must be added for those survivors who must adjust themselves to the climate, altitudes, and the task of backpacking. Survivors should also allow time for unexpected obstacles and problems which could occur.

Proper nutrition and water are essential to building and preserving energy and strength. Several small meals a day are preferred to a couple of large ones so that calories and fluids are constantly available to keep the body and mind in the best possible condition. Survivors should try to have water and a snack available while traveling, and they should eat and drink often to restore energy and prevent chills in cold temperatures. This also applies at night.

Land Travel Techniques

Land travel techniques are based largely on experience, which is acquired through performance. However, experience can be partially replaced by the intelligent application of specialized practices that can be learned through instruction and observation. For example, travel routes may be established by observing the direction of a bird's flight, the actions of wild animals, the way a tree grows, or even the shape of a snowdrift. Bearings read from a compass, the Sun, or stars will improve on these observations and confirm original headings. All observations are influenced by the location and physical characteristics of the area where they are made and by the season of the year.

Route Finding. The beginner should follow a compass line, whereas the experienced person follows lines of least resistance by realizing that a curved route may be faster and easier under certain circumstances. Use game trails when they follow a projected course only. For example, trails made by migrating caribou are frequently extensive and useful. On scree or rock-slides, mountain sheep trails may be helpful. Game trails offer varying prospects, such as the chance of securing game or locating waterholes. Successful land travel requires knowledge beyond mere travel techniques. Survivors should at least have a general idea of the location of their starting place and their ultimate destination. They should also have knowledge of the people and territory through which they will travel. If the population is hostile, they must adapt their entire method of travel and mode of living to this condition.

Wilderness. Wilderness travel requires constant awareness. A beginner views a landscape from the top of a hill with care and interest, and says, “let's go.” The experienced person carefully surveys the surrounding countryside. A distant blur may be mist or smoke; a faint, winding line on a far-off hill may be manmade or an animal trail; a blur in the lowlands may be a herd of cattle. People should plan travel only after carefully surveying the land. Study distant landmarks for characteristics that can be recognized from other locations or angles. Careful and intelligent observation will help survivors to correctly interpret the things they see, distant landmarks, or a broken twig at their feet. Before leaving a place, travelers should study their backtrail carefully. Survivors should know the route forward and backward. An error in route planning may make it necessary to backtrack in order to take a new course. For this reason, all trails should be marked (fig. 4-37).

Mountain Ranges. Mountain ranges frequently affect the climate of a region and the climate in turn influences the vegetation, wildlife, and the character and number of people living in the region. For example, the oceanside of mountains has more fog, rain, and snow than the inland side of a range. Forests may grow on the oceanside, while inland, it may be semi-dry. Therefore, a complete change of survival techniques may be necessary when crossing a mountain range.

Travel in mountainous country is simplified by clear drainage landmarks, but it is made more difficult by the roughness of the land. A mountain traveler can readily determine the direction in which rivers or streams flow; however surveying is necessary to determine if a river is safe for rafting, or if a snowfield or mountainside can be crossed safely. Mountain travel differs from travel through rolling or level country, and certain rules govern climbing methods. A group descending into a valley, where descent becomes increasingly steep and may be required to climb up again in order to follow a ridge until an easier descent is possible. In such a situation, descending with a parachute line rope may save many weary miles of travel. In mountains, travelers must avoid possible avalanches of earth, rock, and snow, as well as **crevasses** in ice fields.

Crevasses: Deep cracks in the ice.

In mountainous country, it may be better to travel on ridges—the snow surface is probably firmer and there is a better view of the route from above. Survivors should watch for snow and ice overhanging steep slopes. Avalanches are a hazard on steep snow-covered slopes, especially on warm days and after heavy snowfalls.

Snow avalanches occur most commonly and frequently in mountainous country during wintertime, but they also occur with the warm temperatures and rainfalls of springtime. Both small and large avalanches are a serious threat to survivors traveling during winter as they have tremendous force. It is difficult to definitely predict avalanches, but knowing general behaviors of avalanches and how to identify them can help people avoid avalanche hazard areas.

Snow or Sluff Avalanche. The loose snow or sluff avalanche is one kind of avalanche that starts over a small area or in one specific spot. It begins small and builds up in size as it descends. As the quantity of snow increases, the avalanche moves downward as a shapeless mass with little cohesion.

Terrain Factors Affecting Avalanches:

1. Steepness. Most commonly, avalanches occur on slopes ranging from 30 to 45 degrees (60 to 100 percent grade), but large avalanches do occur on slopes ranging from 25 to 60 degrees (40 to 173 percent grade). (fig. 4-38).

2. Profile. The dangerous slab avalanches have more chance of occurring on convex slopes because of the angle and the gravitational pull. Concave slopes cause a danger from slides that originate at the upper, steep part of the slope.

3. Slopes. Midwinter snowslides usually occur on north-facing slopes. This is because the north slopes do not receive the required sunlight which would heat and stabilize the snowpack. South-facing slope slides occur on sunny, spring days when sufficient warmth melts the snow crystals causing them to change into wet, watery, slippery snow. Leeward slopes are dangerous because the wind blows the snow into well packed drifts just below the crest. If the drifts have not adhered to the snow underneath, a slab avalanche can occur. Windward slopes generally have less snow and are compact. It is usually strong enough to resist movement, but avalanches may still occur with warm temperature and moisture.

4. Surface Features. Most avalanches are common on smooth, grassy slopes that offer no resistance. Brush, trees, and large rocks bind and anchor the snow, but avalanches can still occur in tree areas (fig. 4-39).

Weather Factors. Old snow depth covers up natural anchors (rocks, brush, and fallen trees) so that the new snowfall slides easier. The type of old snow surface is important. Sun crests or smooth surface snows are unstable; whereas a rough, jagged surface would offer stability and an anchorage. A loose snow layer underneath is far more hazardous than a compacted one as the upper layer of snow will slide more easily with no rough texture to restrain it. Travelers should check the underlying snow by using a rod or stick. A high percentage of all avalanches occur during or shortly after storms. Layers of different types of snow from different storms will cause unstable snow because the bond between layers will vary in strength. The rate of snowfall also has a significant effect on stability. A heavy snowfall spread out over several days is not as dangerous as a heavy snowfall in a few hours because slow buildup allows time for the snow to settle and stiffen. A large amount of snow over a short period of time results in the snow constantly changing and building up, giving it little time to settle and stiffen. If the snow is light and dry, little settling or cohesion occurs, resulting in instability. Under extremely cold temperatures, snow is unstable. In temperatures around freezing or just above, the snow tends to settle and stabilize quickly. Storms, starting at low temperature with light, dry snow which are followed by rising temperature, cause the top layer of snow to be moist and heavy, providing opportune conditions for avalanching. The light, dry snow underneath lacks the strength and elastic bondage necessary to hold the heavier, wetter snow deposited on top; therefore, the upper layer slides off. Also, extreme temperature differences between night and day cause the same problems. Rapid changes in weather conditions cause adjustments and movement within the snowpack. Survivors should be alert to rapid changes in winds, temperatures, and snowfall which may affect snow stability. Avalanches of wet snow are more likely to occur on south slopes. Sun, rainstorms, or warmer temperatures brought by spring weather are absorbed by the snow causing it to become less stable.

Warning Signs. Avalanches generally occur in the same area. After a path has been smoothed, it's easier for another avalanche to occur. Steep, open gullies and slopes, pushed over small trees, limbs broken off, and tumbled rocks, are signs of slide paths. Snowballs tumbling downhill or sliding snow is an indication of an avalanche area on leeward slopes. If the snow echoes or sounds hollow, conditions are dangerous. If the snow cracks and the cracks persist or run, the danger of a slab avalanche is imminent. The deeper the snow, the more the terrain features will be obscured. Knowledge of common terrain features can help survivors visualize what they may be up against, what to avoid, and the safest areas to travel. Knowing the general weather pattern for the area is helpful. Survivors should try to determine what kind of weather will be coming by observing and knowing the signs that indicate certain weather conditions.

Route Selection. If avoiding the mountains and avalanche danger areas are impossible, there are precautions survivors should take when confronting dangerous slopes. They should decide which slopes will be the safest by analyzing the factors that determine what makes one slope safe and another deadly. Study the slope terrain and keep in mind why avalanches occur.

When survivors decide to cross a slope, one person at a time should cross. If all go together, they should not tie together since there is no way one person can hold another against an avalanche. Instead, they should tie a contrasting color line about 100 feet long (using suspension line or PLD tape) to each person. If they should get caught in an avalanche, the line will help identify their position if it is exposed. Survivors should select escape routes before and throughout the climb and keep these routes in mind at all times. They should also stay to the fall line when climbing and not zig-zag or climb a different route because it seems easier. Staying to the fall line will prevent making fractures and at the same time, compact the snow, making it more stable for others who follow. If traversing, they should travel above the danger area. Survivors should travel quickly and quietly to avoid extended exposure to the probable danger of avalanches.

If caught in an avalanche, any equipment that weighs survivors down should be dropped. The pack, snowshoes, and any other articles should be jettisoned.

The standard rule is to use swimming motions to try to move towards the snow surface. Further, survivors should go for the sides and not try to out swim the avalanche. If near the surface, they should try to keep one arm or hand above the surface to mark their position. If buried, a person should inhale deeply (nose down) before the snow stops moving to make room for their chest. Trapped persons should try to make breathing space around their faces. They shouldn't struggle, but should relax and conserve their energy and oxygen. Only when fellow survivors or rescuers are nearby should the trapped individual shout. Rescue should be done as quickly as possible. Avalanche victims generally have a 50 percent chance of surviving after 30 minutes have passed because the snow will set up (harden).

Glaciers may offer emergency travel routes across mountain ranges. Glacier crossing demands special knowledge, techniques, and equipment such as the use of a lifeline and poles for locating crevasses. There are many places where mountain ranges can be negotiated on foot in a single day by following glaciers. Survivors must be especially careful on glaciers and watch for crevasses covered by snow. If traveling in groups of three persons or more, they should be roped together at intervals of 30 to 40 feet. Every step should be probed with a pole. Snow-bridged crevasses should be crossed at right angles to their course. The strongest part of the bridge can be found by probing. When crossing a bridged crevasse, weight should be distributed over a large area by crawling or by wearing snowshoes.

When forested areas are dense, river travel and ridges usually afford the easiest travel routes. In open forests, land travel is easier and offers a better selection of travel routes.

After a fire, windstorm, or logging operation, second-growth timber usually grows thick. It is worse after it grows about 20 feet high since any space between the trees is filled in by branches and the overhead timber isn't (yet) thick enough to cause the lower branches to die from lack of sunlight.

- **Deciduous brush** also contributes to the overgrowth. Blowdowns, avalanche fans, and logging slush are difficult to negotiate. Such obstructions, even a few hundred feet may require major changes to the original travel route.

- **Scrub cedar** (subalpine fir) is hard to penetrate. There are tactics that can be used to make travel easier. Survivors can use fallen trees as walkways to provide a short route of travel through the scrub cedar to a clear area. Gloves should be worn when penetrating thorny vegetation. Overlaying bushes can be separated to allow passage. When land is steep, brush can be used to provide handholds if it is strong and anchored well.

- **Brush** can be dangerous. Survivors should be aware of the possibility of slipping while going downhill. Therefore, they should ensure each step is firmly placed. Survivors should be aware of travel difficulties presented by cliffs, boulders, and ravines which are covered by brush.

Do not travel through dense brush if it can be avoided.

Travel on trails rather than taking shortcuts through the brush. Brush is frequently easier to travel through (over) during the winter season when it is covered by snow and when snowshoes are available (improvised).

During the summer, avoid avalanche tracks because the debris may be difficult to penetrate. Traveling on the "timber cones" between avalanche paths is best when climbing a valley.

The heaviest timber is the best area to travel because little or no brush will be growing on the forest floor.

Try to avoid areas near creeks and valley floors because they have more brush and trees than the valley walls and ridges. However, traveling in the stream channels may be preferable when the area is covered with dense brush and vegetation. Survivors may have to wade, but the stream may offer the best route through the brush.

Traveling high above the brush at the timberline may be worthwhile if the bottom and sides of the valley look useless.

Snow and Ice Areas. Travel in snow and ice areas is not recommended except to move from an unsafe to a safe area, or from an area that has few natural resources to an area of greater resources (shelter material, food, and signaling area).

Before traveling to a possible rescue site, town, village, or cabin, travelers should know their approximate position and the location of the desired site. The greatest hazard in snow and ice areas is the intense cold and high winds. Judging distance is difficult due to the lack of landmarks and the clear arctic air. Image disfigurement is a common occurrence. “White-out” conditions exist and the survivor should not travel during this time. A white-out condition occurs when there is complete snow cover and the clouds are so thick and uniform that light reflected by the snow is about the same intensity as that from the sky. If traveling during bad weather, great care must be taken to avoid becoming disoriented or falling into crevasses, over cliffs or high snow ridges, or walking into open leads. A walking stick is very useful to probe the area in the line of travel.

Strong winds often sweep unchecked across tundra areas (due to the lack of vegetation) causing white-out conditions. Because of blowing snow, fog, and lack of landmarks, a compass is a must for travel, yet it is still difficult to navigate a true course since the magnetic variation in the high latitudes (polar areas) is often extreme.

During the summer months, the area is a mass of bogs, swamps, and standing water. Crossing these areas will be difficult at best. Rain and fog are common. Insects such as mosquitoes, midges, and black flies can and will cause the survivor physical discomfort and may cause travel problems. If the body is not completely covered with clothing, or if survivors do not use a head net or insect repellant, insect bites may be severe and infection can set in.

In mountainous country, it is often best to travel along ridge lines because it provides a firmer walking surface and there is usually less vegetation to contend with. High winds make travel impractical if not impossible at times. Glaciers have many hidden dangers. Glacial streams may run just under the surface of the snow or ice, creating weak spots, or they may run on the surface and cause slick ice. Crevasses which run across the glacier can be a few feet to several hundred feet deep. Quite often crevasses are covered over with a thin layer of snow, making them practically invisible. Survivors could fall into crevasses and suffer serious injuries or death. If glacier travel is required, it is best to use a probe pole to test the footing ahead.

Summer travel in timbered areas should not present any major problems; however, travel on ridges is preferred since the terrain is drier and there are usually fewer insects. During the cold months, snow may be deep and travel will be difficult without some type of snowshoes or skis. Travel is generally easier on frozen rivers, streams, and lakes since there is less snow or wind-packed snow and they are easier to walk on.

River and stream travel can be dangerous. Rivers comparatively straight are that way because of the volume of water flow and extremely fast currents. These rivers tend to have very thin ice in the winter (cold climates), especially where snowbanks extend out over the water. If an object comes through the ice, the direct area will be weak and should be avoided if possible. Where two rivers and streams come together, the current is swift and the ice will be weaker than the ice on the rest of the river. Very often after freezeup, the source of the river or stream dries up so rapidly that air pockets are formed under the ice and can be dangerous if fallen into. During the runoff months (spring and summer), rivers and streams usually have a large volume of water which is very cold and can cause cold injuries. Wading across or down rivers and streams should be done with proper footwear and exposure protection due to the depth, swiftness, unsure footing, and coldness of the water. Generally, streams are too small and shallow for rafting. Streams are often bordered by high cliffs or banks at the headwaters. As a stream progresses, its banks are often choked with alder, devil's club, and other thick vegetation making traveling very slow and difficult. Many smaller streams will simply lead the traveler to a bog or swamp where they end, causing more problems for the survivor.

Floe: Floating ice formed in a large sheet on the surface of a body of water.

Sea ice conditions vary greatly from place to place and season to season. During the winter months, there is generally little open water except between the edges of **floes**. Crossing from one floe to another can be done by jumping across the open-water area, but footing may be dangerous. When large floes are touching each other, the ice between is usually ground into fragments of ice by the action of the floes against each other and this ground-up ice will not support a survivor's weight. Pressure ridges are long ridges in sea ice caused by the horizontal pressure of two ice floes coming together. Pressure ridges may be 100 feet high and several miles long; they may occur in a gulf or bay, or on polar seas. They must be crossed with great care because of the ruggedness of ice formations, weak ice in the area, and possibility of open water covered with a thin layer of snow or ground-up ice. During summer months, the ice surface becomes very rough and covered with water. The ice also becomes soft and honeycombed (candlestick ice) even though the air temperature may be below freezing. Traveling over sea ice in the summer months is very dangerous.

Icebergs are great masses of ice and are driven by currents and winds; about two-thirds of the iceberg is below the surface of the sea. Icebergs in open seas are always dangerous because the ice under the water will melt faster than the surface exposed to the air, upsetting the balance and turning them over. The resulting waves can throw small pieces of ice in all directions. Avoid pinnacle-shaped icebergs—low, flat-topped icebergs are safer.

Dry Climates. Before traveling in the desert, the decision to travel must be weighed against the environmental factors of terrain and climate, condition of survivors, possibility of rescue, and the amount of water and food required.

The time of day for traveling is greatly dependent on two significant factors; the first and most apparent is temperature, and the second is type of terrain. For example, in rocky or mountainous deserts, the collapsed drainages and canyons may not be seen at night and could result in a serious fall. Additionally, manmade features such as mining shafts or pits and irrigation channels could cause similar problems. If the temperature is not conducive to day travel, survivors should travel during the cooler parts of the day (in early morning or late evening). Traveling on moonlit nights is another possibility; however, survivors must be aware that moonlight can cast deceiving shadows. This problem can be decreased by scanning the ground to allow the night sensitive portions of the eye time to pick up the slight differences in lighting. In hot desert areas where these hazards do not occur, traveling at night is a very practical solution. During the winter in the mid-latitude deserts, the cold temperatures make day travel most sensible.

There are three types of deserts: mountain, rocky plateau, and sandy or dune deserts. These deserts can present difficult travel problems.

Mountain deserts are characterized by scattered ranges or areas of barren hills or mountains, separated by dry, flat basins. High ground may rise gradually or roughly from flat areas to a height of several thousand feet above sea level. Most desert rainfall occurs at high elevations and the rapid runoff causes flash floods, deep ditches and depositing sand and gravel around the edges of the basins. These floods are a problem on high and low grounds. The flood waters rapidly evaporate, leaving the land as dry as before except for plush vegetation which rapidly stop growing. Basins without shallow lakes will have **alkaline** flats which can cause problems with chemical burns and can destroy clothing and equipment.

Rocky plateau deserts have relief distributed by spacious flat areas solid or broken rock at or near the surface. They may be cut by dry, steep-walled, collapsed valleys, known as **wadis** in the Middle East and gullys or canyons in the United States and Mexico. The narrower of these valleys can be very dangerous to humans and material due to flash flooding. Travel in these valleys may present another problem: a survivor can lose site of reference points and travel farther than intended. The Golan Heights in Israel is an example of a rocky plateau desert.

Alkaline (akali): A carbonate or hydroxide of an alkali metal, whose watery solution is bitter, slippery, caustic, and typically basic in reactions.

Wadis: A valley, gully, or riverbed in northern Africa and southwestern Asia that remains dry except during the rainy season.

Sandy (dune) deserts are spacious flat areas covered with sand or gravel. They are the product of ancient and modern wind erosion (carrying away the soil). “Flat” is relative in this case, as some areas contain sand dunes that are over 1,000 feet high and 10 to 15 miles long. Travel in such terrain depends on windward or leeward shape of the dunes and texture of sand. These dunes help a survivor determine general direction. Longitudinal dunes are continuous banks of sand at even heights that lie parallel with the dominant wind. Other areas, however, may be totally flat for distances in excess of 2 miles. Plant life varies from none to scrub reaching over 6 feet. Examples of this desert include the Sahara Desert, Empty Quarter of the Arabian Desert, areas of California and New Mexico, and the Kalahari Desert in South Africa. A seif dune has forms similar to a drift behind a rock. Its length lies in the direction of the winds. Additionally, the horseshoe-shaped crescent dune has a hollow portion that faces downward. Ripples caused by wind in the sand may indicate the direction of the prevailing winds. These ripples generally lie perpendicular to the prevailing winds. In deserts, it is easier to travel on the windward side of the tops of dunes. Even though these ridges may not lay in a straight lie and may wander, they offer a better route of travel than traveling in straight lines. A great deal of energy and time can be expended walking up and down dunes, especially in the loose sand on the leeward side of dunes.

People who travel the desert at night orient themselves by the stars and Moon. Those who travel by day use compasses, when available, and the Sun. Survivors should use all directional aids during emergency travel and each aid should be frequently cross-checked against each other. For desert travel, a compass is a valuable piece of equipment.

Without a compass, landmarks must be used for local navigation. This can lead to difficulties. Mirages cause considerable trouble. Ground haze throughout the day may obscure vision. Distances are deceptive in the deserts and survivors have reported difficulty in estimating distances and the size of objects. In southern Egypt, one survivor reported large boulders always appeared smaller than they were and in other cases small obstacles appeared overwhelming. Survivors in Saudi Arabia and in Tunisia warned that it is difficult to maintain a single landmark in navigation. Several groups reported they found it necessary to take turns keeping an eye on a specific mountain, peak, or object which was their goal. Objects have a way of vanishing in some cases when the eye is moved for an instant, and in other cases, many peaks or hills looked alike and caused difficulties in determining the original object. In Tunisia, twin peaks are not reliable landmarks because of their frequent occurrence. (Survivors have found after a short time of traveling they may have up to a dozen twin peaks for reference in the same area.) The Great Sand Sea (Egypt and Libya) was the emergency landing site of several groups of survivors and caused navigational difficulties. In these rolling sand hills, it is impossible to keep one object in view, and even footmarks fail to provide a reliable backtrail for determining travel directions. The extreme flatness of other stretches of desert terrain in North Africa also makes navigation difficult. With no landmarks to follow, no objectives to sight, survivors may walk in circles or large half circles before realizing their difficulties.

A Marine pilot who made an emergency landing in the Arizona desert took the precaution of immediately spreading his parachute on the ground and putting rocks on the edges to ensure maximum visibility from the air. Then he decided to walk to his crashed plane, a distance he estimated to be 500 yards from his landing spot. He reached the plane and found it gutted by fire, and spent 5 days wandering the flat desert trying to find his parachute.

Arcacia: A tropical tree with compound leaves and tight small yellow or white flower clusters.

Navigational difficulties of a different type may be experienced in Ethiopia, Kenya, and Somalia. Here the density of the thorn brush, even though it was primarily **acacia** with small leaves, makes it very hard to navigate from one point to another. In this area, survivors should follow animal trails and hope they lead to rivers or waterholes. Elephant trails seem to offer the best and clearest route.

In the Sinai Desert area and in portions of Egypt, travel routes may be used; survivors can “stay put” on the trails. One survivor, who made a trail, encountered a camel caravan almost immediately, although he reported it bothered him that he had not seen them approach, as they suddenly appeared out of a mirage. Another commented it was awfully hard to be alone in his section of the desert, for in every direction, he saw wandering tribes, camel herds, or people watching him. Two survivors independently suggested that survivors pay attention to the wind as an aid in navigation. One survivor, on the Arabian Peninsula, noted the wind blew consistently from the same direction. The other, in the Libyan Desert, made the same comment and said he was able to judge his direction of travel by the angle at which the wind blew his clothes or struck his body. Survivors in certain areas may orient themselves to the prevailing winds once it is established that these are consistent.

People who walked across the North African deserts had much to say about the local environment and little of it was complimentary. The extreme temperatures bothered them most. It was extremely hot during the day and often bitter cold at night, especially during January and February.

The bright sunlight was hard on their eyes, limbs (arms and legs), and exposed skin. The blinding effects of the Sun reflecting off the terrain caused many persons to express concern regarding sunglasses. Several built fires and smoked their goggles to obtain protection against the glare. Lenses alone do not protect the eyes enough from glare.

Sunglasses may be improvised to reduce this problem. Light-skinned individuals tend to sunburn faster and more severely than darker-skinned individuals. Some reported that no amount of previous suntanning seemed to make any difference. The heat affected their feet and hands. Survivors reported that the surface became so hot their feet were blistered through their shoes. Exposure of bare hands to the sunlight resulted in painful burns. Placing sunburned hands in bare armpits gave considerable relief since the armpits were one of the few places on the body where a person could find continuous perspiration to aid in cooling.

The persistent winds of desert areas seem to provide no cooling effect, and several survivors found the constant blowing of the wind “got on their nerves.” More significant is the fact that the constant winds usually carried an amount of sand or dirt particles. These particles got in eyes, ears, nostrils, and mouth and caused irritations which were often severe. Additionally, this persistent wind also caused ear-aches. One survivor reported that the abrasions of the eyes by the particles of dust reached a point where first the man's eyes watered so much that he could not see, and eventually the watering stopped and "emery cloth eyelids remained," making life miserable for him.

Extreme winds blow sandstorms which last from a few minutes to months. Generally, survivors reported they could see the approach of such storms and were able to take proper precautions; however, sandstorms completely surprised a few groups and they had difficulty navigating. None of the survivors who experienced sandstorms in the northern desert underestimated the power and danger of such storms. Protection from the storms was uppermost in their minds. Most survivors used rock mounds, natural ledges, boulders, depressions, or wells for shelter. Survivors had time to dig depressions and rig a shelter from blankets, parachutes, or tarpaulins (waterproof material, as canvas). A few wrapped themselves in their parachutes and endured the storm in a prone position.

Nearly all of these people had some comment to make on orientation before, during, and after a sandstorm. They warned specifically that it is necessary to mark the direction of travel before the storm. A few survivors said when the storm was over they had no idea which way they had been traveling and all their landmarks were forgotten, destroyed, or they couldn’t recognize them. The general plan for marking travel routes before a sandstorm is to place a stick to indicate direction. One survivor oriented himself with one rock a few feet in front of his position. He commented after the storm, that one point was not satisfactory and recommended using a row of stones, sticks, or heavy gear about 10 yards in length to give capable direction following such an emergency.

Mirage: An optical effect that is sometimes seen at sea, in the desert, or over a hot pavement, that may have the appearance of a pool of water or a mirror in which distant objects are seen inverted, and that is caused by the reflection of rays of light by a layer of heated air of varying density.

Refraction: Clear positional altitude of celestial objects resulting from deflection of light entering the Earth’s atmosphere.

Several survivors reported they learned the hard way to keep their mouths shut in the desert. This meant breathing through the mouth caused drying and talking not only got on the other's nerves but also caused excessive drying of the mucous membranes.

Mirages are common in desert areas. The most common desert mirage occurs during the heat of the day when the air close to the ground is much warmer than the air above. Under this condition, atmospheric **refraction** is less than normal and the image of the distant low sky appears on the ground looking like a sheet of water. Distant objects may appear to be reflected in the “water.” When the air close to the ground is much colder than the air above, as in the early morning under a clear sky, atmospheric refraction is greater than normal. When this condition occurs, distant objects appear larger and closer than they are and objects below the normal horizon are visible. Unless the density distribution in the lower layers is such that the light rays from an object reach the observer along two or more paths, they will see a disfigured image or multiple images of the object.

Reports of mirages were very common in the survival episodes examined. In most cases, they were recognized as mirages and only caused minor difficulties. No survivor reported these mirages actually represented bodies of water. While traveling, the survivor experienced problems as a result of mirages. Distances could not be judged because the present terrain was hidden by the mirage. Mirages limited vision and navigation since it concealed objects. Additionally, mirages "magnified some objects and concealed others." One man hunting in the heat of the day reported that when he sighted an animal, it ran into or hid in a mirage. The lower layer of hot air which causes the mirage, commonly called desert haze, limits vision and disfigures objects. Signaling difficulties resulted from this since sighting an image on an object was clearly very difficult due to the low haze on the desert.

Several survivors reported cases of imaginary illusions which were due to the haze or mirages. One group looked for a hill, for a viewpoint, so long that the entire party began to see hills in all directions. They finally held a conference to iron out their difficulties and all settled on one hill which the group should approach. Everyone in the party saw the hill, and the group walked an estimated 9 miles looking for the hill which never existed and which eventually disappeared into the desert flatness. Dawn and dusk illusions also occurred and were reported in the survivors' stories. One group was severely troubled with the false-dawn mysterious light on the western horizon. The fact that the Sun at first appeared to be rising in the west caused anxious moments. Another party had one person who claimed he saw a flashing beacon on the evening horizon. The pilot explained the illusion as the occasional refraction of bright starlight near the horizon, through the residual heat waves of the cliff before them. But one crewmember was so convinced it was a beacon that he started walking to investigate this object and was never seen again.

The following are manmade characteristics of the desert:

Roads and trails are rare in the desert, as complex road systems are not needed. Most existing road systems have been used for centuries to connect centers of commerce or important religious shrines, such as Mecca and Medina in Saudi Arabia. These roads are now supplemented by routes for transporting oil or other mineral deposits to collection points. Primary trails exist in many deserts for convoys and traveling tribesmen. These trails have wells or **oasis** approximately every 20 to 40 miles, although there are waterless stretches of over 100 miles. These trails vary in width from a few yards to over 800 yards. Vehicle travel in mountainous desert terrain may be severely restricted. Available routes may be easily blocked by hostile people or climatic conditions. Passes may be blocked by snow in the winter. The travel distance on foot or by animal between two points in the mountains may be less than a tenth of the distance required if vehicles are used to make the trip.

Oasis: A fertile or green spot, especially one with water, in a desert.
Refinery: An industrial plant used for purifying a crude substance, as petroleum.
Quarries: Open mining or pits from which stone is obtained.

Apart from traveling tribesmen who live in tents, desert inhabitants live in thick-walled structures with small windows, usually built of masonry or a mud and straw (adobe) mixture. The ruins of earlier civilizations are scattered across the deserts. Ancient posts and forts always command important avenues of approach and frequently dominate the only available passes in difficult terrain. Control of these positions may be important for forces set on controlling the immediate area.

Exploration for and exploitation of natural resources, of which oil is the best known, occurs in many desert areas, especially the Middle East. Wells, pipelines, **refineries**, **quarries**, and crushing plants may lead a survivor to rescue or captivity. Additionally, pipelines are often elevated, making them visible from a distance.

Many desert areas are irrigated for agricultural and habitation purposes. Agriculture and irrigation canals are signs which can lead a survivor to people.

Tropical Climates. The inexperienced person's view of jungle travel may range from difficult to nearly impossible. However, with patience and good planning, the best and least difficult route can be selected. In some cases, the easiest routes are rivers, trails, and ridge lines. However, there may be hazards associated with these routes.

Rivers and streams may be overgrown making them difficult to reach and impossible to raft. These waterways may also be infested with leeches. Trails may have traps or animal pits set on them. Trails can also lead to a dead end or into thick brush or swamps. Ridges may end abruptly at a cliff. The vegetation along a ridge may also conceal cracks or extend out past cliffs, making the cliff unnoticed until it's too late.

The **machete** is the best aid to survival in the jungle. However, survivors should not use it unless there is no other way. They should part the brush rather than cut it if possible. If the machete must be used, cut at a down-and-out angle, instead of flat and level, as this method requires less effort.

Survivors should take their time and not hurry. This allows them to observe their surroundings and gives better insight as to the best route of travel. Watch the ground for the best footing as some areas may be slippery or give way easily. Avoid grabbing bushes or plants when traveling. Falling may be a painful experience as many plants have sharp edges, thorns, or hooks. (NOTE: Wear gloves and fully button clothes for personal protection.)

Quicksand can be a problem. In appearance, quicksand looks just like the surrounding area with an absence of vegetation. It is usually located near the mouths of large rivers and on flat shores. The simplest description of quicksand is a natural water tank filled with sand and supplied with water. The bottom consists of clay or other substances capable of holding water. The sand grains are rounded, as opposed to normal sharper-edged sand. This is caused by water movement which also prevents it from settling and stabilizing. The density of this sand-water solution will support a person's body weight. The danger if a survivor panics may be drowning. In quicksand, the survivor should use the spread-eagle position to help disperse the body weight to keep from sinking and a swimming technique to return to solid ground.

Machete: A large heavy knife with a broad blade, used as a weapon and for cutting vegetation.

Note: Remember to avoid panicking and struggling, and spread out and swim or pull along the surface.

Mountain Walking Techniques

Depending upon the terrain formation, mountain walking can be divided into four different techniques—walking on hard ground, walking on grassy slopes, walking on scree slopes, and walking on talus slopes. Included in all of these techniques are two basic rules which must be mastered in order to expend a minimum of energy and time.

These rules are:

- The weight of the body must be kept directly over the feet.
- The sole of the boot must be placed flat on the ground.

These rules are most easily accomplished by taking small steps at a slow steady pace. Any angle of downfall which is too steep should be avoided and any sections or bulges of the ground, however small, should be used to advantage.

Hard ground is usually considered to be firmly packed dirt which will not give way under the weight of a person’s step. When ascending, the above rules should be applied with the addition of locking the knees on every step in order to rest the leg muscles (fig. 4-41). When steep slopes are encountered, they can be climbed sideways easier than climbed straight up. Turning at the end of each crossing should be done by stepping off in the new direction with the uphill foot (fig. 4-42). This prevents crossing the feet and possible loss of balance. In traversing, the full sole principle is done by rolling the ankle away from the hill on each step. For narrow stretches, the herringbone step may be used; that is, ascending straight up a slope with toes pointed out (fig. 4-43) and using the principles stated above. Descending is usually easiest by coming straight down a slope without traversing. The back must be kept straight and the knees bent (fig. 4-44) in such a manner that they take up the slack of each step. Again, remember the weight must be directly over the feet, and the full sole must be placed on the ground with every step.

Grassy slopes are usually made up of small **tussocks** of growth rather than one continuous field. In ascending, the techniques previously mentioned are appropriate; however, it is better to step on the upper side of each tussock (fig. 4-45) where the ground is more level than on the lower side. Descending is best done by crossing at an angle.

Scree slopes consist of small rocks and gravel which have collected below rock ridges and cliffs. The size of the scree varies from small particles to the size of a fist. Occasionally, it is a mixture of all size rocks, but normally scree slopes will be made up of rocks the same size. Ascending scree slopes is difficult, tiring, and should be avoided when possible. All principles of ascending hard ground apply, but each step must be picked carefully so the foot will not slide down when weight is placed on it. This is best done by kicking in with the toe of the upper foot so a step is formed in the scree (fig. 4-46). After determining the step is stable, carefully transfer weight from the lower foot to upper and repeat the process. The best method for descending scree is to come straight down the slope with feet in a slight pigeon-toed position using a short shuffling step with the knees bent and back straight (fig. 4-47). When several climbers descend a scree slope together, they should be as close together as possible, one behind the other, to prevent injury from dislodged rocks. Since there is a tendency to run down scree slopes, care must be taken to ensure that this is avoided and control is not lost. By leaning forward, one can obtain greater control. When a scree slope must be traversed with no gain or loss of altitude, use the hop-skip method. This is a hopping motion in which the lower foot takes all the weight and the upper foot is used for balance.

Talus slopes are similar in makeup to the scree slopes, except the rock pieces are larger. The technique of walking on talus is to step on top of, and on the uphill side of, the rocks (fig. 4-48). This prevents them from tilting and rolling downhill. All other previously mentioned fundamentals are applicable. Usually, talus is easier to ascend and traverse, while scree is a more desirable avenue of descent.

Tussocks: A clump of growing grass.

Burden Carrying

Backpacking is essential when heavy loads must be carried for distances. Using a suitable harness and following certain approved packing and carrying techniques can eliminate unnecessary hardships and help in transporting the load with greater safety and comfort. Carrying a burden initially creates mental irritation and fatigue, either of which can lower morale. Survivors should keep their minds occupied with other thoughts when packing a heavy load. Adjustments should be made during each rest stop to improve the fit and comfort of the pack. Additionally, the rate of travel should be adjusted to the weight of the pack and the environmental characteristics of the terrain being crossed.

Burden carrying is a task that must be done in most survival environments. Often survivors must quickly gather their equipment and move out without the assistance of a good pack. The gear may have to be carried in the arms while rapidly leaving the area. In such an instance, it would be better to fashion a roll of the gear and wear it over the shoulder, time permitting. When time is not a factor, it may be desirable to make a semirigid pack such as a square pack. The convenience of being able to keep track of equipment, particularly small items, can be critical in survival situations.

Packsack

A packsack can be fashioned from available survival kit containers or several layers of the fabric from the parachute canopy, clothing, animal skins, canvas, plant fiber, and many other materials. The sack is sewed with inner core and a needle.

Square Pack

The following instructions explain how to improvise a square pack (fig. 4-49). Lay a rectangle of material, waterproof if available, (5 feet by 5 feet minimum size) flat on the ground (fig. 4-49A). Visualize the material divided into squares like a tic-tac-toe board. The largest piece of soft, bulky equipment (sleeping bag, parachute canopy, etc.) is placed in the center square in an “S” fold. This places the softest item in the pack against the tarp which rests on the back while traveling. If using a poncho, place the sleeping bag just below the hood opening (fig. 4-49B). Place hard, heavy objects between the top layer and the middle layer of the “S” fold near the top of the pack. Soft items can be placed between the middle and bottom layer (fig. 4-49C).

After all desired items are inside the folds, tie the inner pack in the fashion shown in figure 4-49D. Start with a 1-inch diameter loop in the end of a long piece of parachute suspension line or other suitable line and loop it around the “S” fold laterally. Standing at the bottom of the pack, divide it into thirds and secure the running end of the line to the loop with a trucker's hitch. Both of these hitches should be at the intersection of the thirds so as to divide the pack vertically into thirds. Wrap the running ends around the pack at 90 degrees (working toward the center) to the line and when it crosses another line, use a jam (postal) hitch to secure it and pull both ways to ensure tightness in all directions. When returning to the original starting position, use the loop of the tied trucker's hitch to secure another trucker's hitch and the inner part is complete (fig. 4-49D). The waterproof materials are then folded around the inner pack as shown in figure 4-49E. Tie the “outer” pack in the same manner ensuring that it is waterproof with all edges folded in securely. If a poncho is used, the head portion may be used to get into the pack if necessary. However, it must be properly secured to ensure that the inner items are protected. With a square pack constructed in this manner, there is no reason why the equipment should get wet. (Note: With practice, an excellent pack can be constructed by tying the inner pack and outer cover simultaneously.)

Horseshoe Pack

The horseshoe pack has been referred to by many names in history including the “Johnny Reb Pack,” “cigarette pack,” “bed roll,” and others. It is simple to make and use and relatively comfortable to carry over one shoulder. It is constructed as follows (fig. 4-50): Lay available square-shaped (preferably 5 feet by 5 feet) material (waterproof if available) flat on the ground (fig. 4-50A) and place all gear on the long edge of the material, leaving about 6 inches at each end. All hard items should be padded. Roll the material with the gear to the opposite edge of the square (fig. 4-50B). Tie each end securely. Place at least two or three evenly spaced ties around the roll. Bring both tied ends together and secure. This pack is compact and comfortable if all hard, heavy items are packed well inside the padding of the soft gear. If one shoulder is injured, the pack can be carried on the other shoulder. It is easy to put on and remove (fig. 4-50C).

The most widely used improvised packstrap is called an Alaskan packstrap (fig. 4-51). This type of packstrap can be fashioned out of any flexible and strong material. Some suitable materials for constructing the packstrap are animal skins, canvas, and parachute harness webbing. The pack should be worn so it can be released from the strap with a single pull of the cord in the event of an emergency, such as falling into water. The knot securing the pack should be made with an end readily available which can be pulled to drop the pack quickly; for example, a trucker's hitch with safety for normal terrain travel and with the safety removed when in areas of danger, such as water or rough terrain.

Some advantages of the Alaskan packstrap are:

- Small in bulk and light in weight.
- Easily carried in a pocket while traveling.
- Quickly released in an emergency.
- Can be adjusted to efficiently pack items of a variety of shapes and sizes.
- Can be used with a tumpline to help distribute the weight of the pack over the shoulders, neck, and chest, thereby eliminating sore muscles and chafed areas.

Some disadvantages of the Alaskan packstrap are:

- Difficult to put on (without practice).
- Experience and ingenuity are necessary to use it with maximum efficiency.

The following principles should be considered when packing and carrying a pack:

- The pack or burden-carrying device should be adequate for the intended job.
- The pack or burden may be adaptable to a pack frame. The pack frame could have a belly band to distribute the weight between the shoulders and hips and prevent undue swaying of the pack. Pack frames are also used to carry other burdens such as meat, brush, and firewood.
- Proper weight distribution is achieved by ensuring that the weight is equally divided on each side of the pack and as close as possible to the body's center of gravity. This enhances balance and the ability to walk in an upright position. If heavy objects are attached to the outside of the pack, the body will be forced to lean forward. A pack bundle without a frame or packboard should be carried high on the back or shoulders. For travel on level terrain, weight can be carried high. When traveling on rough terrain, weight should be carried low or midway on the back to help maintain balance and footing.
- Emergency and other essential items (extra and/or protective clothing, first-aid kit, radio, flashlight, etc.) should be readily available by being placed in the top of the pack.
- Fragile items are protected by padding them with extra clothing or some soft material and placing them in the pack where they won't shift or bounce around. Hard and/or sharp objects cannot damage the pack or other items if cutting edges are properly covered, padded, and not pointed toward the bearer. Items outside the pack should be firmly secured but not sticking out where they could snag on branches and rocks.
- Adjust and carry the pack so that overloading or straining of muscles or muscle groups is avoided. When using a pack, the straps should be adjusted so they ride comfortably on the **trapezius** muscles and avoid movement when walking. Back support should be tight and placed to ensure circulation of air and support. During breaks on the trail, rest using the proper position to ease the weight of the pack and take the strain off muscles. See figure 4-52 for methods of resting. A comfortable pack is adjustable to the physique of the person. A waistband will support 80 to 90 percent of the weight and is fitted relatively tight. The waistband should be cinched down around the pelvic girdle/crest area to avoid constricting circulation or restricting muscle movement.
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Trapezius Muscle: A large flat triangular muscle of the shoulder and upper back.

Tumpline: A strap slung across the forehead or the chest to support a load carried on the back.

A **tumpline** is an excellent aid to burden carrying since it transfers part of the weight of the pack to the skeletal system (fig. 4-53).

Tumpline Construction:

Attach a soft band, which rests on the upper forehead, to the pack by using light line. Make the band of any strong, soft material, such as animal skin with hair, tanned skin, an old sock, or parachute cloth. Make the hand long enough to reach over the forehead and down to a point opposite each ear. A tumpline does not require any sewing.

Adjust the tumpline to fit the head by making loops at the ends. It is difficult to reach down and behind to make necessary adjustments of the pack, but a person can easily reach up and adjust the pack by using the loops on either side of the forehead.

Make mainstrings from rawhide or parachute suspension lines. Tie them to the lower corners of the pack, bring them up to the loops at the ends of the tumpline, and tie them with a slipknot. Experience is needed to estimate proper adjustments before putting on the pack; however, adjustments can always be made after the packstraps are adjusted.

Tumpline Use. The tumpline should be tight enough to transfer about half of the weight of the pack/burden from the shoulders to the head. Occasionally, a heavy pack may cut off the blood circulation to the shoulders and arms. In such cases, a tumpline is of great value. By slight adjustments, most of the weight can be transferred to the head and neck, thereby loosening the shoulder straps and permitting circulation to return to numb arms. A tumpline may cause the neck muscles to be sore for the first few days due to the unusual strain placed on them however, this discomfort soon disappears. With practice, heavy weights can be supported with only the neck and head. A tumpline can also be used to pack animal **carcasses**, firewood, or equipment. Since it can be rolled up and carried in a pocket, it can be a real aid to survival.

Carcass: The dead body of a slaughtered animal.